Hypothesis Testing Checkpoint

Question (1)

A study was conducted in order to estimate μ, the mean number of weekly hours that U.S. adults use computers at home. Suppose a random sample of 81 U.S. adults gives a mean weekly computer usage time of 8.5 hours and that from prior studies, the population standard deviation is assumed to be σ = 3.6 hours.

A similar study conducted a year earlier estimated that μ, the mean number of weekly hours that U.S. adults use computers at home, was 8 hours. We would like to test (at the usual significance level of 5%) whether the ***current*** study provides significant evidence that this mean has changed since the previous year.

Using a 95% confidence interval of (7.7, 9.3), our conclusion is that:

A: the current study ***does*** provide significant evidence that the mean number of weekly hours has changed over the past year, since 8 falls outside the confidence interval.
B: the current study ***does not*** provide significant evidence that the mean number of weekly hours has changed over the past year, since 8 falls outside the confidence interval.
C: the current study ***does*** provide significant evidence that the mean number of weekly hours has changed over the past year, since 8 falls inside the confidence interval.
D: the current study ***does not*** provide significant evidence that the mean number of weekly hours has changed over the past year, since 8 falls inside the confidence interval.
E: None of the above. The only way to reach a conclusion is by finding the p-value of the test.

Feedback

A : 0

✗ This is not quite right. Notice that 8 falls within the confidence interval. Consider the remaining options. (D) is the correct answer.

B : 0

✗ This is not quite right. Notice that 8 falls within the confidence interval. Consider the remaining options. (D) is the correct answer.

C : 0

✗ This is not quite right. Since 8 falls within the confidence interval, we would not have enough evidence to suggest that the mean has changed. Consider the remaining options. (D) is the correct answer.

D : 10

✓ Good job! We are interested in testing: H_0: $\mu = 8$ vs. H_a: $\mu \neq 8$. Since the 95% confidence interval (7.7, 9.3), contains 8 (in other words, 8 is a plausible value for μ), we do not have enough evidence to reject H_0 and conclude that the mean has changed.

E : 0

✗ This is not quite right. The p-value will be below 5% if 8 is not within the 95% confidence interval and the p-value will be above 5% if 8 is within the 95% confidence interval. Consider the remaining options. (D) is the correct answer.

Question (2)

Which of the following facts about the p-value of a test is correct?

A: The p-value is calculated under the assumption that the null hypothesis is true.

B: The smaller the p-value, the more evidence the data provide against H_0.

C: The p-value can have values between -1 and 1.

D: All of the above are correct.
E: Just (A) and (B) are correct.

Feedback

A : 0

✗ This is not quite right. Although it is true that the p-value is calculated under the assumption that the null hypothesis is true, there is a better option. Consider the remaining options. (E) is the right answer.

B : 0

✗ This is not quite right. Although it is true that the smaller the p-value, the more evidence the data provide against H_0, there is a better option. Consider the remaining options. (E) is the right answer.

C : 0

✗ This is not quite right. Since the p-value is a probability, it must be between 0 and 1. Consider the remaining options. (E) is the right answer.

D : 0

✗ This is not quite right. Since the p-value is a probability, it must be between 0 and 1. Consider the remaining options. (E) is the right answer.

E : 10

✓ Good job! Since the p-value is the probability of obtaining a sample like that observed (or even more extreme) assuming that H_0 is true, the p-value is between 0 and 1 (therefore (C) is wrong).

The next two questions refer to the following information:

In June 2005, a CBS News/NY Times poll asked a random sample of 1,111 U.S. adults the following question: "What do you think is the most important problem facing this country today?" Roughly 19% of those sampled answered "the war in

Iraq" (while the rest answered economy/jobs, terrorism, healthcare, etc.). Exactly a year prior to this poll, in June of 2004, it was estimated that roughly 1 out of every 4 U.S. adults believed (at that time) that the war in Iraq was the most important problem facing the country.

We would like to test whether the 2005 poll provides significant evidence that the proportion of U.S. adults who believe that the war in Iraq is the most important problem facing the U.S. has decreased since the prior poll.

Question (3)

Which of the following are the appropriate hypotheses in this case?

A: H_0: p = .19 vs. H_a: p < .19
B: H_0: p = .19 vs. H_a: p > .19
C: H_0: p < .25 vs. H_a: p = .25
D: H_0: p = .25 vs. H_a: p < .25
E: H_0: p = .25 vs. H_a: p not equal to .25

Feedback

A : 0

This is not quite right. Since you would like to test whether or not the population proportion, p, has decreased from 2004, the assumed population proportion should be the same as it was in 2004. Consider the remaining options. (D) is the correct answer.

B : 0

This is not quite right. Since you would like to test whether or not the population proportion, p, has decreased from 2004, the assumed population proportion should be the same as it was in 2004. Consider the remaining options. (D) is the correct answer.

C : 0

This is not quite right. In general, the null hypothesis will assume equality and the alternative hypothesis will involve an inequality. Consider the remaining options. (D) is the correct answer.

D : 10

Good job! We would like to test whether the proportion has decreased from what it was in the previous year (when it was estimated to be .25).

E : 0

This is not quite right. Remember that you want to test whether or not the population proportion has decreased since 2004. You do not want to test if the population proportion is different from 2004. Consider the remaining options. (D) is the correct answer.

Question (4)

The following output is available for this test:

Test and CI for One Proportion

Sample	X	N	Sample p	95% Upper Bound	Z-Value	P-Value
1	211	1111	0.189919	0.209275	-4.62	0.000

The output indicates that: (choose the best answer)

A: We have extremely strong evidence to reject H_0.
B: We have extremely strong evidence to reject H_a.
C: We have moderately strong evidence to reject H_0.
D: There is probability of 0 that H_0 is correct.
E: There is probability of 0 that H_a is correct.

Feedback

A : 10

Good job! A p-value so small (that Minitab reports that it is 0) indicates that it would essentially be almost impossible to obtain data like those observed had H_0 been true. This is extremely strong evidence to reject H_0.

B : 0

This is not quite right. Remember that a small p-value indicates that the observed data would be rare if the null hypothesis were true. Also, we generally reject the null hypothesis or fail to reject the null hypothesis. Consider the remaining options. (A) is the right answer.

C : 0

This is not quite right. Although we do have evidence suggesting that we should reject H_0, the evidence is much stronger than moderate. Consider the remaining options. (A) is the right answer.

D : 0

This is not quite right. A p-value represents the probability of obtaining data at least as extreme as the observed given that the null hypothesis is true. If the p-value is low, it does not mean that the null hypothesis is incorrect; it just means that the obtained data is very rare if it comes from the assumed distribution. Consider the remaining options. (A) is the right answer.

E : 0

This is not quite right. Unless you can poll the entire population, there is no way to determine whether or not the alternative hypothesis is true. Consider the remaining options. (A) is the right answer.

The next three questions refer to the following information:

An automatic coffee machine dispenses cups of coffee whose volume per cup varies normally with the mean $\mu = 10$ oz. A quality-control researcher randomly selects 8 cups of coffee from the machine and finds that in this sample the mean volume is 9.92 oz. and the standard deviation is 0.23 oz.

Question (5)

Do these data provide enough evidence to conclude that the mean volume per cup is below the target level?

Which of the following two outputs represents the correct way to conduct this test?

A:

One-Sample T

```
Test of mu = 10 vs < 10


                                        95%
                                      Upper
N     Mean    StDev  SE Mean      Bound      T      P
8  9.92000  0.23000  0.08132   10.07406  -0.98  0.179
```

B:

One-Sample Z

```
Test of mu = 10 vs < 10
The assumed standard deviation = 0.23


                             95%
                           Upper
N     Mean  SE Mean        Bound      Z      P
8  9.92000  0.08132     10.05376  -0.98  0.163
```

Feedback

A : 10

✓ Good job! This is a case in which the population standard deviation (Ïƒ) is unknown (and is replaced by the sample standard deviation s = 0.23). The sample size is only 8, however, since the variable is known to vary normally, we can safely use the t-test (first output).

B : 0

✗ This is not quite right. The population standard deviation is unknown, so a z-test cannot be used. (A) is the right answer.

Question (6)

Which of the following represents the correct conclusion we can make based on the output you selected in the previous problem (and at the usual significance level of .05)?

A: The data provide enough evidence to reject H_0 and to conclude that the mean volume per cup is lower than the target level of 10 oz.

B: The data provide enough evidence to accept H_0 and to conclude that the mean volume per cup is at the target level of 10 oz.

C: The data do not provide enough evidence to reject H_0, so we accept it, and conclude that the mean volume per cup is at the target level of 10 oz.

D: The data do not provide enough evidence to reject H_0, nor to conclude that the mean volume per cup is lower than the target level of 10 oz.

Feedback

A : 0

✗ This is not quite right. Notice that the p-value is greater than .05. This indicates that there is not enough evidence to suggest that the mean amount of coffee per cup is less than 10 ounces. Consider the remaining options. (D) is the correct answer.

B : 0

✗ This is not quite right. We never accept the null hypothesis. Consider the remaining options. (D) is the correct answer.

C : 0

✗ This is not quite right. We never accept the null hypothesis. Consider the remaining options. (D) is the correct answer.

D : 10

✓ Good job! Since the p-value is relatively large ($p = 0.179$), the only conclusion that we can draw is that the data does not provide enough evidence to reject H_0. ***Remember, we never accept the null hypothesis.***

Question (7)

While it is important for you to know how to apply the methods that are covered in this course, it is also important to be able to recognize situations when none of the methods is appropriate. In this problem, we have made slight changes to the "coffee machine" story.

Your task is to recognize in which of the options below the changes are such that none of the methods covered in this course can be applied for testing H_0: $\mu = 10$ vs. H_a: $\mu < 10$.

A: An automatic coffee machine dispenses cups of coffee whose volume per cup varies according to a distribution with mean $\mu = 10$ oz. A quality-control researcher randomly selects 8 cups of coffee from the machine and finds that in this sample the mean volume is 9.92 oz. and the standard deviation is 0.23 oz.

B: An automatic coffee machine dispenses cups of coffee whose volume per cup varies according to a distribution with mean $\mu = 10$ oz. A quality-control researcher randomly selects 40 cups of coffee from the machine and finds that in this sample the mean volume is 9.92 oz. and the standard deviation is 0.23 oz.

C: An automatic coffee machine dispenses cups of coffee whose volume per cup varies normally with mean $\mu = 10$ oz. and standard deviation $\sigma = 0.23$ oz. A quality-control researcher randomly selects 8 cups of coffee from the machine and finds that in this sample the mean volume is 9.92 oz.

D: An automatic coffee machine dispenses cups of coffee whose volume per cup varies according to a distribution with mean $\mu = 10$ oz. and standard deviation $\sigma = 0.23$ oz. A quality-control researcher randomly selects 8 cups of coffee from the machine and finds that in this sample the mean volume is 9.92 oz.

E: Both (A) and (D) are cases where we cannot run the test using the methods covered in this course.

Feedback

A : 0

✗ This is not quite right. Although this is a case that cannot be handled by any methods you have learned, there is a better option. Consider the remaining options. (E) is the right answer.

B : 0

This is not quite right. You are able to use a t-test for this scenario because the sample size is large. Consider the remaining options. (E) is the right answer.

C : 0

This is not quite right. You are able to use a z-test for this scenario because the population distribution is normal and you are given the population standard deviation. Consider the remaining options. (E) is the right answer.

D : 0

This is not quite right. Although this is a case that cannot be handled by any methods you have learned, there is a better option. Consider the remaining options. (E) is the right answer.

E : 10

Good job! Cases (A) and (D) are both cases where the sample size is small (n = 8) and the population is not given to be normal. Therefore, in case (A) (where the population standard deviation (Ïƒ) is unknown) it would not be safe to use the t-test, and in case (D) (where Ïƒ is known), it would not be safe to use the z-test.